XDMoD Value Analytics

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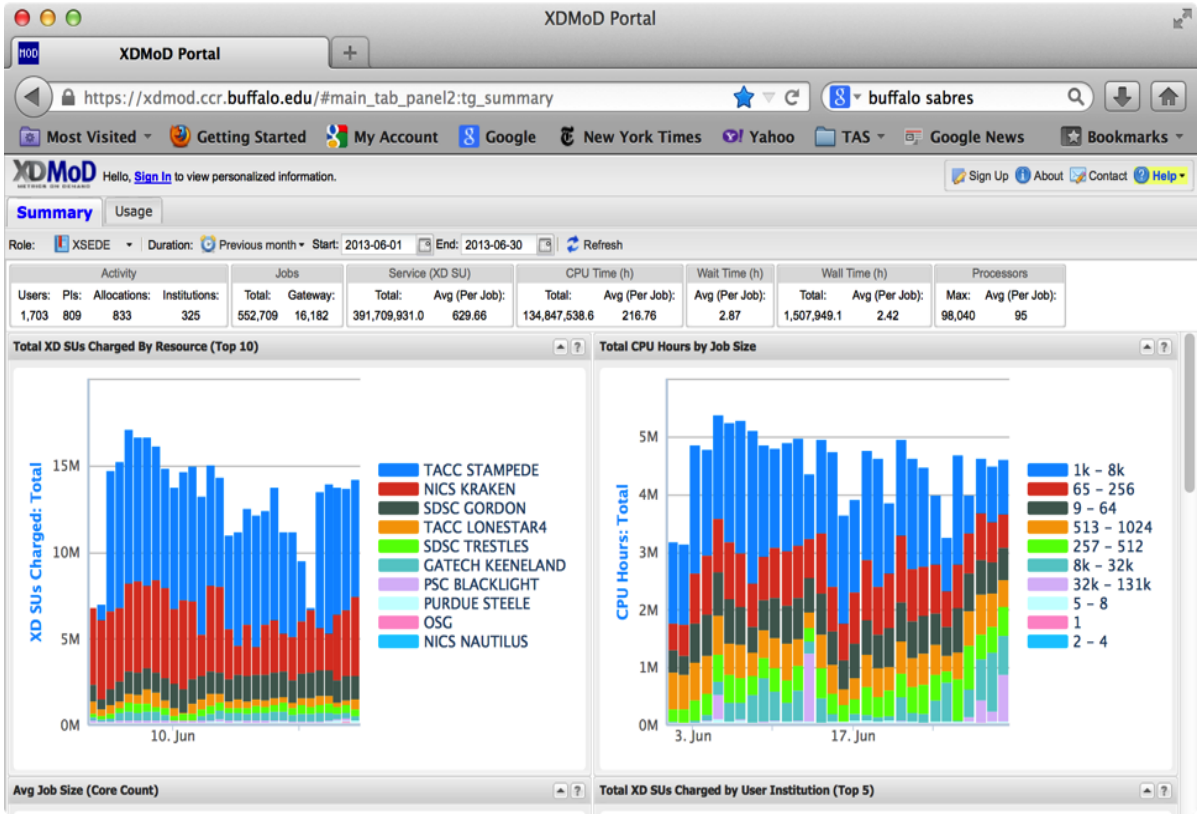
CASC Presentation Outline

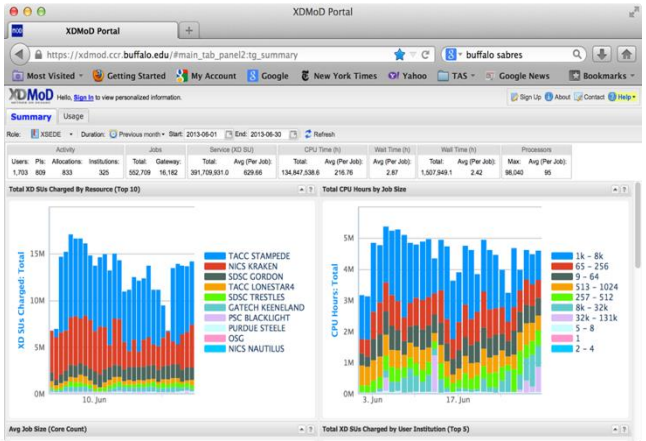
- *XDMoD Overview*
- *XDMoD Value Analytics*
  - *Help measure ROI*
  - *Collaborative project with University of Indiana*



XDMoD: A Tool for HPC System Management

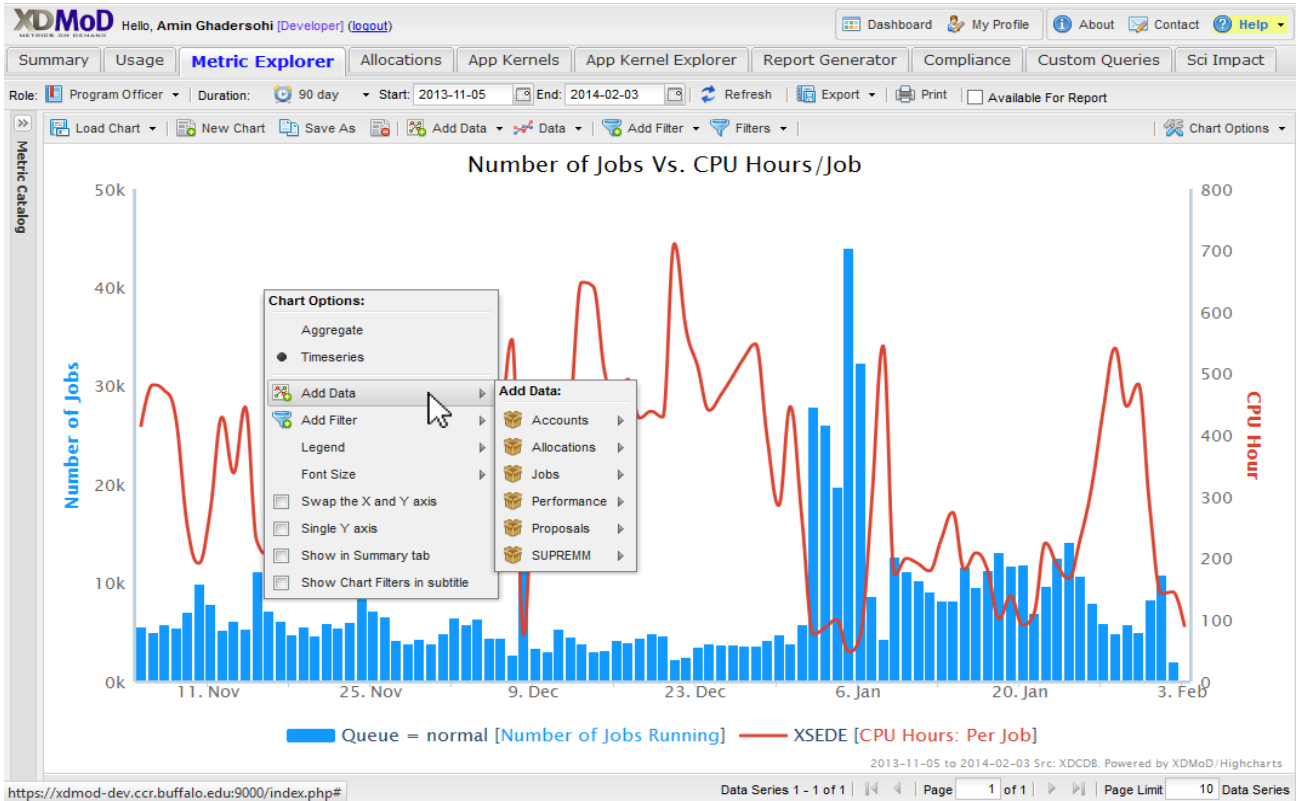
- ***XD Net Metrics Service Award to CCR***
  - *5-year NSF Award*
  - *XDMoD (XSEDE version) and Open XDMoD (for HPC Centers)*
- ***Optimize Resource Utilization and Performance***
  - *Provide instantaneous and historical information on utilization*
  - *Measure Quality of Service*
  - *Measure and improve job and system level performance*
- ***Measure Return on Investment***
  - *Measure Scientific Impact*
    - *Publications, Citations, etc*
  - *Track grants awarded to researchers utilizing HPC resources*
- ***Open XDMoD*: Open Source version for HPC Centers***
  - *100+ academic & industrial installations worldwide*
  - *http://open.xdmod.org/*

XDMoD
METRICS ON DEMAND

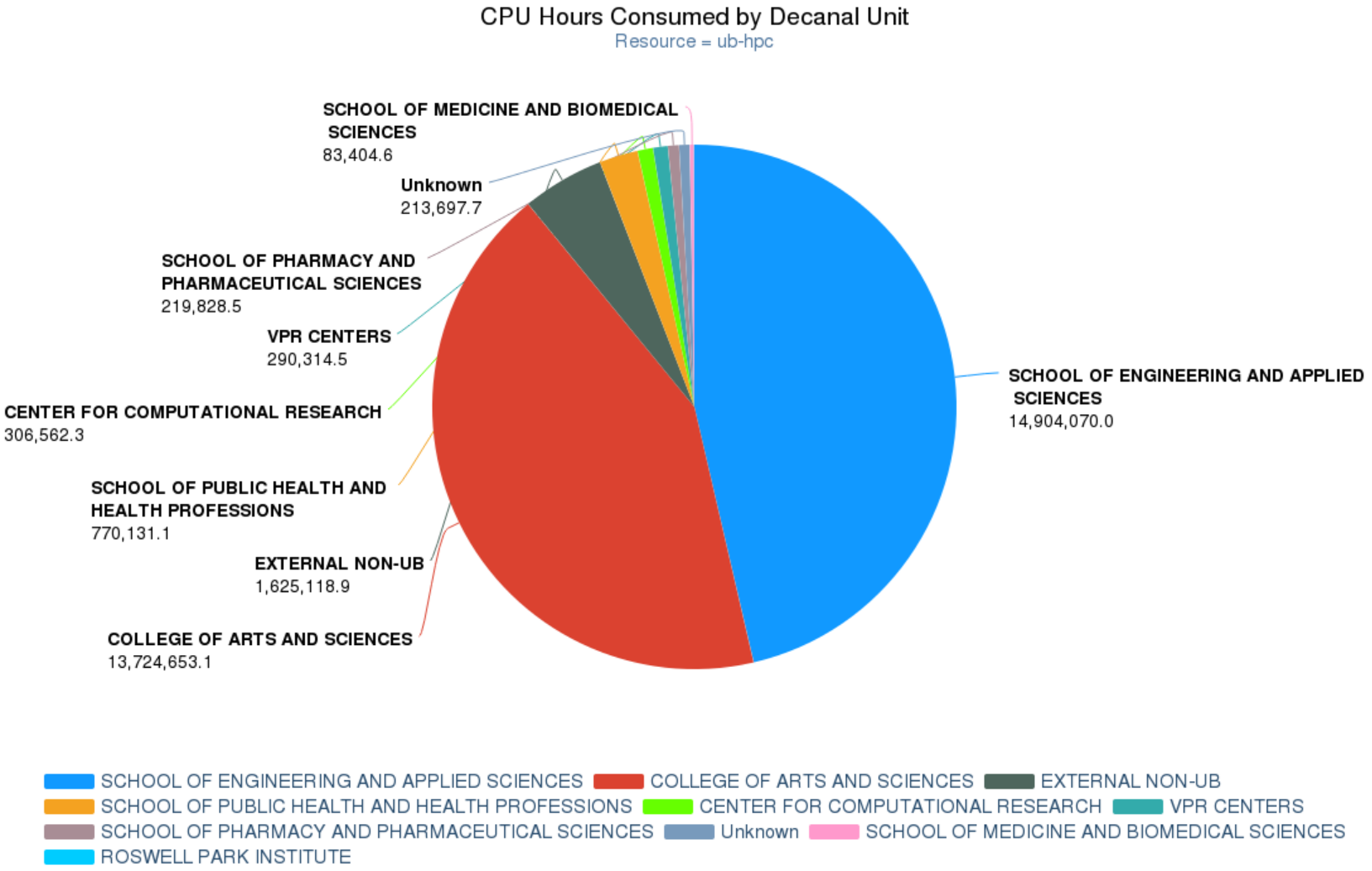


XDMoD Portal

- *Display Metrics – GUI Interface*
  - *Utilization, performance, publications*
  - *Role based*
  - *Custom Report Builder (PDF, Word, Excel)*
- *Measure Quality of Service*
  - *Application Kernels detect poorly performing hardware/software*
- *Measure Job Level Performance*
  - *Job Viewer: Access detailed job level performance data*



CPU Hours Delivered by Decanal Unit

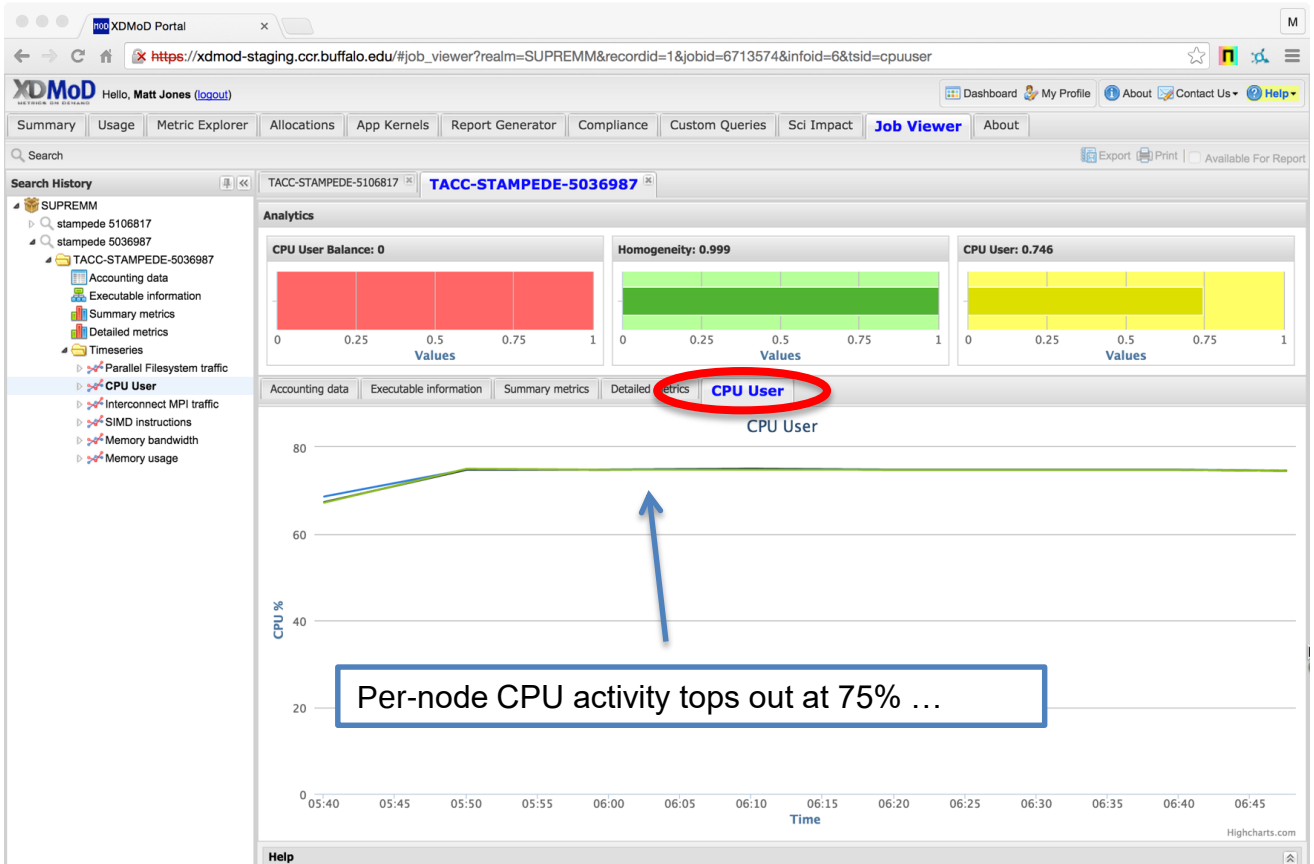


QoS: Application Kernels

- *Computationally lightweight*
  - ***Run continuously** and on demand to actively measure performance*
  - *Utilize open source codes such as GAMESS, NWChem, NAMD, OpenFOAM, etc., as well as customized kernels*
- *Measure system performance from User's perspective*
  - *Local scratch, global filesystem performance, local processor-memory bandwidth, allocatable shared memory, processing speed, network latency and bandwidth*

Measuring Job Level Performance

- ***Integration of XDMoD with Monitoring Frameworks***
  - *Run on every cluster node and collects hardware counter data*
    - *CPU usage, Memory usage, I/O usage*
- ***Identify poorly performing jobs (users) and applications***
  - *HPC consultants/Users can use tools to identify/diagnose problems*



Goals for XDMoD Value Analytics

- *Understanding the financial and intellectual value of campus-based cyberinfrastructure (CI) is intrinsically difficult.*
- *There is often administrative pressure questioning the value of campus-funded CI resources.*
- *XDMoD Value Analytics (VA) is an extension of XDMoD to help provide ROI metrics*
  - *Compare usage to funding and publications.*

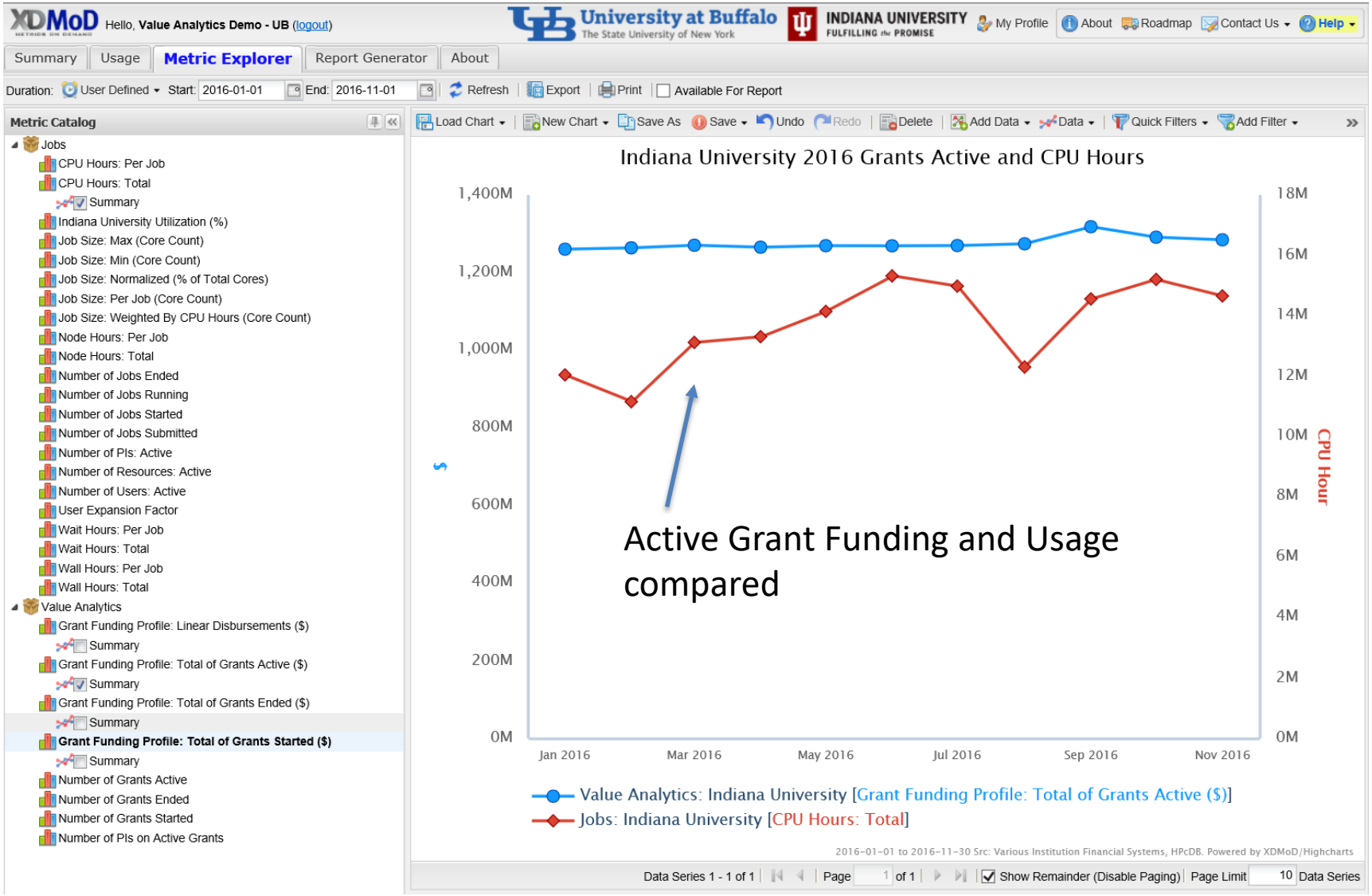
Value Analytics Module

- *Prototype VA Module Developed*
- *Current Instances*
  - *Indiana University*
  - *University at Buffalo, SUNY*
  - *Beta testers*
    - *Nebraska, SDSC, Vanderbilt, Arizona, Texas A&M, Arkansas*

VA Input Data

- *VA data is input in json format*
- *Three json files are required:*
  - *Name of your organization*
  - *Information on all Users: real name and unique id (institution userid)*
  - *Information on all Grants: title, agency, organization grant id, start date, end date, dollars, PI*
  - *XDMoD links PI Name to userid*
- *Total grant funding is PI based (ie, coPI's are not included)*

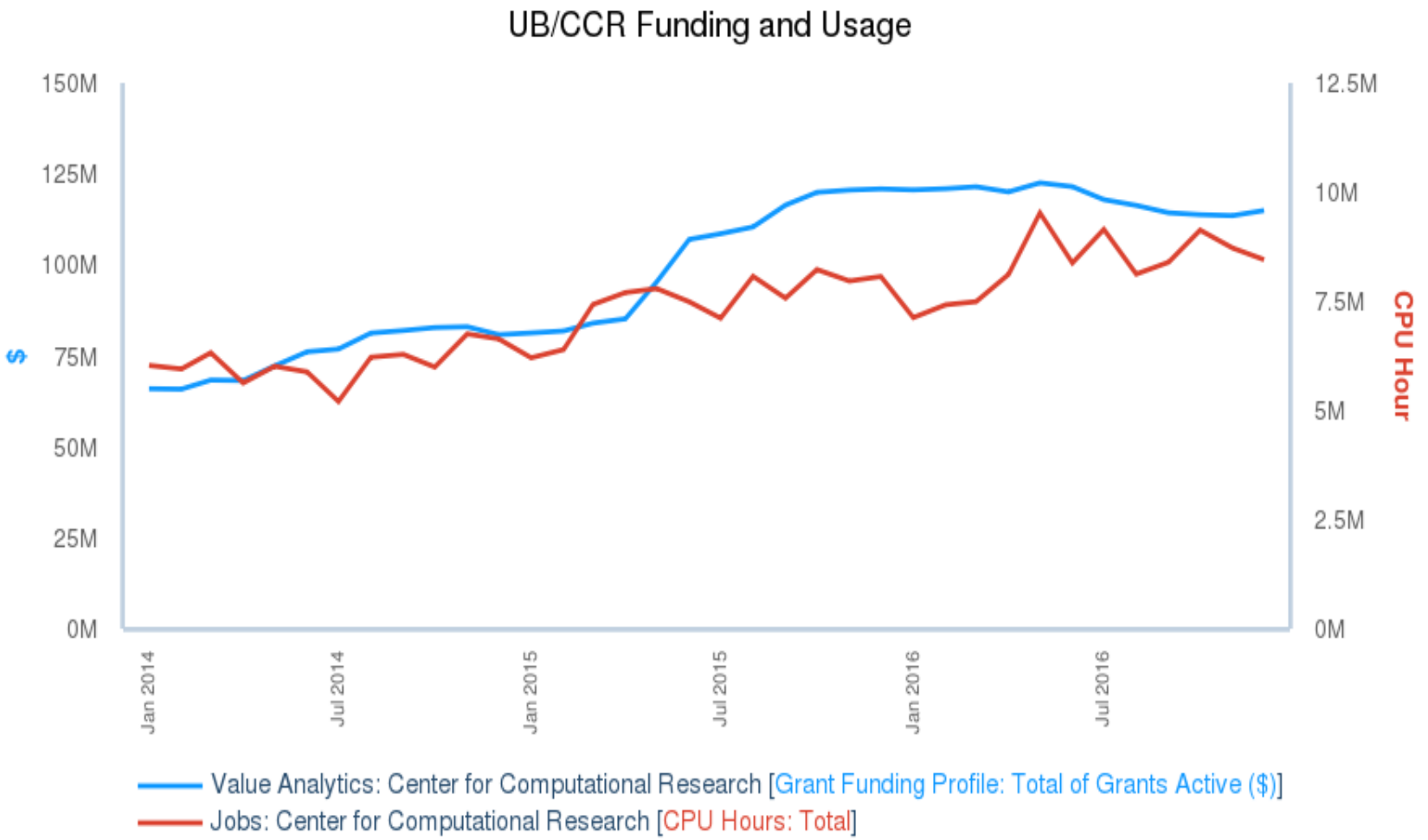
XDMoD VA Realm



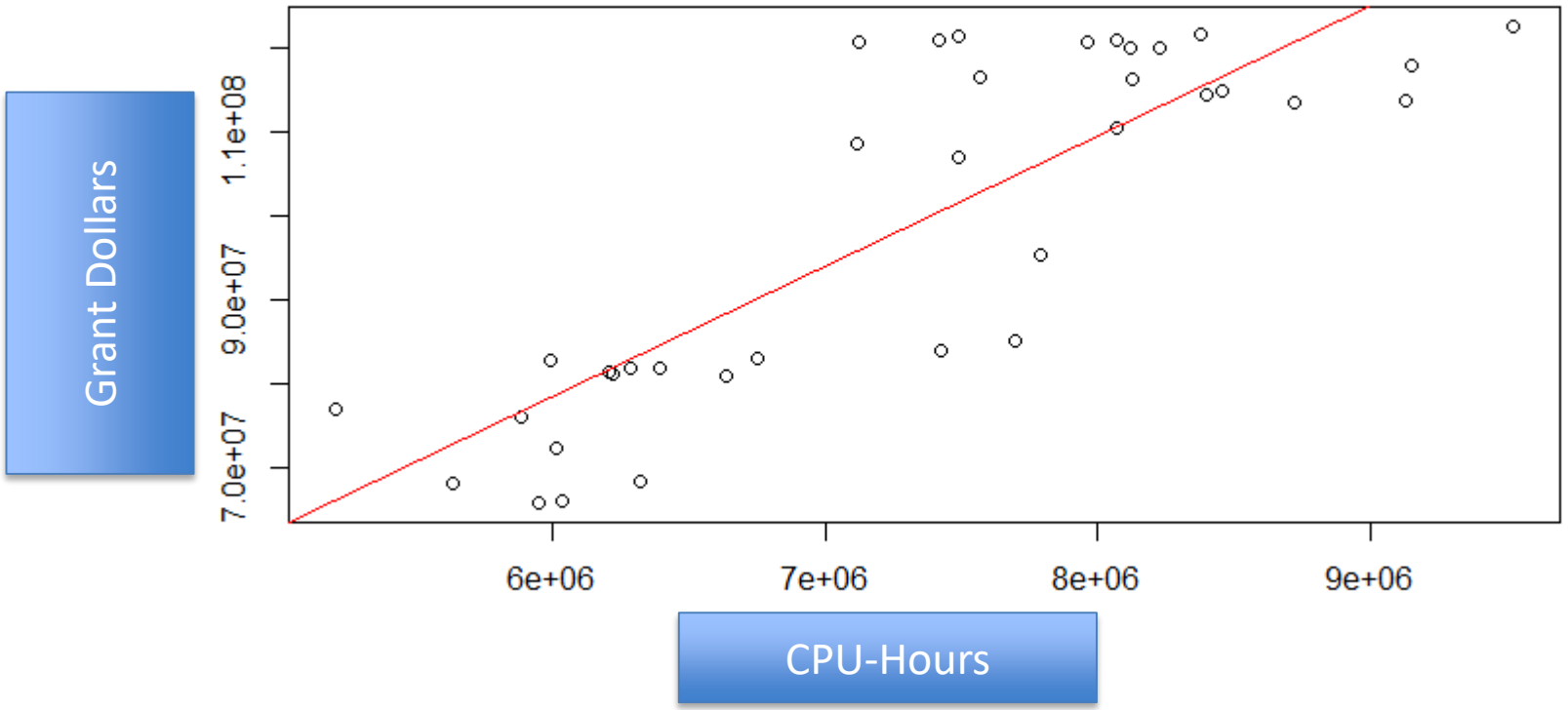
Some Possible VA Analyses

- *Time History*
  - *Grant funding profile*
    - *Assumes each individual grant is uniform over the grant lifetime*
  - *Aggregate of all active grants*
  - *Number of grants active, ended or started*
  - *Number of PIs*
- *All of above can be analyzed by PI, funding Agency or grant*

UB: XDMoD Value Analytics plot of grant dollars and HPC CPU-hours for 2014-2016



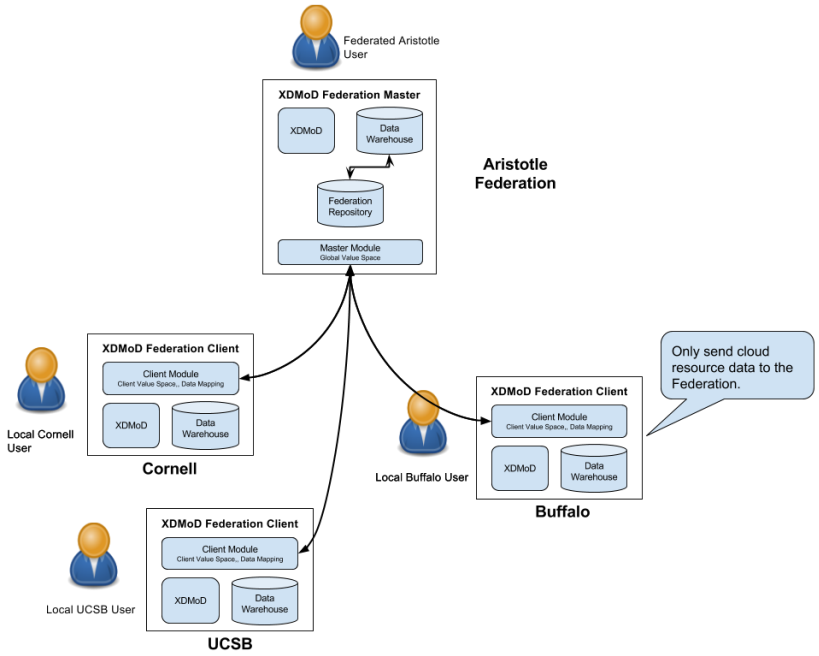
Linear data fit CPU-hours vs grant dollars



Approximate linear correlation between grant dollars and usage over a three year period 2014-2016.

Future Work

- *Value Analytics: Return on Investment*
  - *Correlating HPC Usage with external funding*
  - *Develop tools to automatically import external funding from agencies such as NSF and NIH*
- *Federated Open XDMoD*
- *Cloud Computing Metrics*
- *Continued Development*
  - *XDMoD*
  - *Application Kernels*
  - *Job Level Performance Analysis*



Acknowledgements

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  - ***TACC:*** *Bill Barth, Todd Evans*
- ***XDMoD VA***
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- ***NSF***
  - *TAS: OCI 1025159, SUPReMM: OCI1203560*
  - *XMS: ACI-1445806, VA: 1566393*

Further Information

- *Open XDMoD**
  - *http://open.xdmod.org/*
- *XDMoD Portal Login and Public View*
  - *https://xdmod.ccr.buffalo.edu/*
- *TACC_Stats*
  - *https://github.com/TACC/tacc_stats*

* J.T. Palmer, S.M. Gallo, T. R. Furlani, M. D. Jones, R. L. DeLeon, J. P. White, N. Simakov, A. K. Patra, J. Sperhac, T. Yearke, R. Rathsam, M. Innus, C. D. Cornelius, J. C. Browne, W. L. Barth, R.T. Evans, "**Open XDMoD: A Tool for the Comprehensive Management of High Performance Computing Resources**", *Computing in Science and Engineering*, **17**, No. 4, 52-62, July – August 2015. DOI:10.1109/MCSE.2015.68